The Search for the Universal:

William Buckland and the Diluvial Theory, 1815 – 1836

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Two hundred years after his death, Francis Bacon was still the most powerful figure in English geology at the beginning of the nineteenth century.[1] When the Geological Society of London was established in 1807, its principal members, led by George Bellas Greenough, determined that the primary goal of geology was the accumulation of observations of geological structures. In the terms later created by William Whewell[2], the society was to concentrate on "descriptive geology" and retreat from the stagnant and premature debates over causes and systems of "geological dynamics" that they believed had impaired the progress of their science. Convinced that the time for theorizing was off in the future, the Geological Society, with a nod to Bacon, focused their effort on the production of a national geological map and other visual representations of the strata and formations. Geologists were urged to go out in the field and work cooperatively to secure the foundation of their new science.

Along with the emphasis on data-gathering, Bacon's other hold on English geology, which turned out to be not quite as powerful, was his warning to keep separate the study of God's word from the study of God's works, "that they do not unwisely confound these learnings together." Failure to do so would result in "*Philosophia phantastica, Religio hæretica*," the corruption of both science and religion through the inappropriate combination of "the two books" God has laid before us.[3]

When Rev. William Buckland (1784-1856) broke with the descriptive traditions of the Geological Society and presented his "diluvial theory" in a series of papers between 1816 and 1824, he was accused by critics of ignoring Bacon's warning, and producing exactly the kind of transgression Bacon had said would follow: bad science and bad religion. The existence of physical evidence of a geologically recent discontinuity had been well established long before Buckland's contributions. Jean André Deluc had published in the 1790s a system of Earth history with a catastrophic division approximately 4000 years ago that presented a close correspondence with the Biblical flood event. British diluvialist geologists traced their research back to the work of Alexander Catcott, published in 1768, but by the 1810s, Catcott's form of diluvialism was no longer respected – his "physical theology" was considered to have been excessively speculative, even if it occasionally had produced valuable observations.[4] In the early nineteenth century, a new form of diluvianism began to emerge that seemed to its advocates to have a much stronger empirical basis. To the traditional evidence of gravel was added examinations of valley

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[1] The adherence to "Baconian" methodology by the Geological Society is discussed by Laudan (1977).

[2] Whewell (1838) "Address to the Geological Society" delivered February 16, 1838, *Proc. Geol. Soc.* 2: 632.

[3] Moore (1986), pp. 322-323.

[4] Conybeare (1822), "Introductory Compendium" to Conybeare and Phillips *Outlines of the Geology of England and Wales*, xxv-xxvi. Buckland referred to Catcott's observations in several works, including *Reliquiae Diluvianae* (1823), p. 225.

formations, stratification, and organic remains, all of which seemed to point to some form of great deluge.

The form that Buckland supported was a unified, universal deluge, one that affected the entire globe in the same period. This belief in a single global deluge was not unique, in fact it had been supported by Greenough, Buckland's mentor,[5] but it did depart from the most widely accepted theory of a recent "revolution" – the theory of Georges Cuvier – in the contention that there was a single flood operative at one time throughout the world. To Buckland's critics, the hypothesis of a simultaneous universal event seemed to have been influenced by a desire to associate his deluge with the Biblical flood.[6] Support for this view was provided by Buckland himself in his publications for a general audience where he claimed that his work was harmonizing scripture with geology. In his Inaugural Address as Professor of Geology at Oxford (1819), Buckland stated that "the facts developed by it [geology] are consistent with the accounts of the creation and deluge recorded in the Mosaic writings"[7] and the address was later published with the subtitle "The Connection of Geology with Revelation Explained." In the dedication to the Bishop to Durham of Buckland's popular *Reliquiae Diluvianae* (1823), Buckland declared that geology proves "an event in the reality of which the truth of the Mosaic records is so materially involved."[8] Even many years later, in writing his Bridgewater Treatise *Geology and Mineralogy* (1836), Buckland maintained that he believed his research "will reconcile even the letter of the text of Genesis with the phenomena of Geology."[9]

Given these statements, it is no wonder that Buckland has been typically interpreted as a "reconciler," and that his determined defence of a universal deluge is seen as owing more to Moses than to geological observation. Even now, when the "catastrophism" of the time is customarily accepted as having a sound empirical basis, Buckland is often described as someone who developed his theories before discovering observational support for them, with the result "that science had been twisted to conform to scripture – and that scripture had been twisted at the same time to conform to what Buckland regarded as science."[10] But we will see that Buckland's development of the diluvial theory shows much more interest in geological evidence than in scripture, which largely contradicted the theory Buckland proposed.

There does, however, appear to have been an unmistakable religious influence on his ideas. But Buckland's claims that he was reconciling geology with revealed religion do not seem to be justified by his research, all of which indicated a flood event quite unlike the event described in the Bible. The hypothesis supported in this paper is that Buckland, despite his rhetoric, was never primarily concerned with revealed religion but was more interested in using his geological research in support of natural religion, and specifically to show the unified and

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[5] Greenough (1819), *A Critical Examination of the First Principles of Geology in a Series of Essays*.

[6] e.g. Fitton (1823) in his review of *Reliquiae Diluvianae*, *Edinburgh Review* 39: 230.

[7] Buckland (1820), *Vindicae Geologicae*, p. 3.

[8] Buckland (1823), *Reliquiae Diluvianae*, i.

[9] Buckland (1836), *Geology and Mineralogy*, p. 33.

[10] Rudwick (1976), p. 136; also Albritton (1989), p. 42.

universal presence of God directly discernable in the world uncovered by geology.

The reinterpretation of Buckland's work away from an association to revealed religion has a precedent in the analysis of his use of miracles. Until the late 1960s it was accepted by historians that Buckland argued in favour of God's direct interference in the world,[11] and this view is supported by all but the most careful reading of Buckland. In his popular works, which is the only place Buckland explicitly discusses God and theology, there almost seems to be an effort to appear to be supporting miraculous modifications. It is now acknowledged that Buckland did not advocate miracles,[12] but the frequent implications of miracles in his work shows that Buckland sometimes wrote in a way to make the connection of his ideas with revealed religion seem stronger than they really were.

Development of the diluvial theory, 1815-1825

The extreme degree of empiricism held by Greenough, the first president of the Geological Society, was such that he found the use of the word "strata" to be a theoretical intrusion.[13] But even though Greenough forcefully campaigned against theorizing, there was at least one case where he had no hesitation about speculating on causes. After spending years in the field observing valleys and the debris of rocks, often of a composition different from local deposits, that pervaded the surface, Greenough concluded that the evidence "proves that, at some time or another, an Inundation has taken place in all countries" and suggests "not only that a Deluge has swept over every part of the globe, but probably the same Deluge."[14] He approved the geological reality of a universal deluge while rejecting completely even the possibility of universal geological formations.[15] Strata in many countries were observed to have similar characteristics, but the leap from this observation to the conclusion that these individual strata were all parts of a single global formation was too much for Greenough to accept. He completely rejected the possibility that a universal stratigraphic table could be produced, and while other geologists were occupied in uncovering the order of the strata around Britain, Greenough devoted himself to creating the geological map of the uppermost formations.

The theological significance of the geological evidence of a universal deluge was plain, but Greenough did not himself present geology as being supportive of the Mosaic account of Noah's flood. The geologist who did accept that task was William Buckland, appointed Reader in Mineralogy at Oxford in 1813, and who from 1812 to 1816 travelled extensively with Greenough around Britain and the Continent cataloguing surface formations for the geological map. Like his mentor, Buckland believed that geology proved there had been a universal deluge, but he parted with Greenough on the existence of universal formations. For Buckland, the strata provided the

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[11] The two most notable instances: Cannon (1960), "The Problem of Miracles in the 1830s," *Isis* 4: 6, and Hooykaas (1963), *Natural Law and Divine Miracle*. 2nd ed.

[12] See Cannon's *DSB* essay on Buckland, vol. ii: 572.

[13] Greenough (1819), *First Principles of Geology*, p. 25. He did use the word himself, but after a note of caution.

[14] Greenough (1819), p. 155.

[15] Ibid. pp. 222-225.

basis for a history of the earth that was generally unified, but Greenough's interpretation could lead only to a unconnected set of local histories. Much of Buckland's research was devoted to the identification and correlation of strata, and the construction of what he called "histories." These were accounts of the development particular neighbourhoods which, taken together, presented an outline of the stages of earth history.

Though Greenough was Buckland's mentor, the most significant influence on his geology was Georges Cuvier, considered by Buckland to be "the greatest naturalist and one of the greatest philosophers that have arisen in distant ages,"[16] and whose name was frequently cited by Buckland in support of his own theories. Cuvier's ideas became widely known in Britain through Robert Kerr's translation of his *Ossemens Fossiles* (1811), published as the *Theory of the Earth* in 1813. In Cuvier's opinion, geological evidence showed that the formation of the present surface of the earth and the life on it were both recent, and that existing causes are insufficient to produce the changes that had occurred. Cuvier supported the view that there was a long period of earth history that extended before the first appearance of human beings, and that there had been several sudden but natural revolutions throughout history. On the most recent of these, Cuvier wrote what would become a favourite citation among British diluvialists:

> if there is any circumstance thoroughly established in geology, it is, that the crust of our globe has been subjected to a great and sudden revolution, the epoch of which cannot be dated much further back than five or six thousand years.[17]

This revolution caused the destruction of strata, the distribution of debris and rounded pebbles, and the entombment of many animals, but its effects were felt one continent at a time – it was not a simultaneous worldwide event. Like Greenough, Cuvier disapproved of speculative systems and he did not relate his theories to scripture. But in notes added to the translation by Robert Jameson, founder of the Wernerian Natural History Society and editor of the *Edinburgh Philosophical Journal*, the claim was made not only that the duration and extent of the Biblical deluge was confirmed by geology, but that it could be equated to Cuvier's most recent revolution.[18]

The key evidence used by Cuvier was the result of a systematic study of fossil bones, a field in which he was the recognized master. Buckland believed that Cuvier had established "the perfect method"[19] in his development of comparative anatomy, through which principles that applied to all animals from all times could be derived, finding a unity through individually distinct specimens. It was precisely the same kind of analysis that Buckland wanted to achieve in his geology, in areas outside of the study of organic remains: finding the underlying unity in the extensive local deposits of diluvium. In Cuvier's methods, Buckland saw a way to enable

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[16] Buckland (1832) "On the Fossil Remains of the Megatherium" *Report BAAS* 1831 1832, p. 104. Buckland begins his report with a eulogy for Cuvier, who had died shortly before the BAAS meeting.

[17] Quoted from Kerr's translation in Copleston (1823), review of *Reliquiae Diluvianae*, *Quarterly Review* 29: 144.

[18] Quoted in Playfair's review of *Theory of the Earth*, in *Edinburgh Review* 22(1814), p. 469.

[19] Buckland (1832), p. 104.

naturalists "to extend their inquiries over the almost boundless regions of the organized world," bringing together fauna from all parts of the world – and all times – under universal principles of design.[20]

The debate between local and universal revolutions immediately emerged over Cuvier's theories. John Playfair, the leading supporter of Hutton's geology, emphasized this differentiation of catastrophes in his review of Cuvier's essay for the *Edinburgh Review*.[21] Local catastrophes, particularly those involving the fracture and depression of the land, were accepted by Playfair as being a frequent occurrence in earth history. He also conceded that some quadrupeds may have been buried by such local catastrophes, but certainly not of all those found throughout the world in the "alluvial beds"[22] (which Buckland later distinguished as "diluvium"). According to Playfair, only local catastrophes could be demonstrated by the evidence, and although he felt it was certain that gradual causes were not responsible for all observed geological effects, Playfair insisted that their power had been greatly undervalued by Cuvier. The long acting force of running water would require "nothing but time to bring the surface to its present condition."[23]

Jameson's addendum on the geological support for the Noachian deluge was a specific target of Playfair's review. Playfair advanced what would become a familiar critique of the attempt to connect geology with the Biblical deluge by emphasizing the great differences between the conceivable effects of the event described in the Bible with the physical confirmations being attributed to it by Jameson. The waters of the flood of the Bible came from 40 days of rain which covered the earth for 150 days, and which then gradually receded until they had completely withdrawn about a year from their first appearance (Genesis 7 and 8). For Playfair, it was impossible that a flood of this short duration could have left any lasting marks.[24] But Playfair did not quite claim that the deluge had been completely quiet. Only two effects could "with certainty" be deduced from the description in the Bible: "the destruction of land animals and the deposition of a coat of mud over the face the earth." These marks, Playfair supposed, would be quickly erased. The carcasses of the dead animals would be swept away to the sea by the retreating waters of the deluge or "would soon be consumed." The mud would be "washed down by the rains, or added to the general mass of vegetable mould."[25] Playfair challenged Jameson to point to any existing phenomena which could be called "monuments of the deluge."

There is good reason to conclude that Playfair's ideas had quite an impact on Buckland. In April 1814, three months after the essay appeared in the *Edinburgh Review*, Buckland was preparing to deliver his first series of lectures on the structure of the earth, and wrote to his friend and frequent travelling companion William Conybeare asking him for his notes on "Moses and

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[20] Ibid.

[21] Playfair (1814), *Edinburgh Review* 22: 454-475.

[22] Ibid., p. 460.

[23] Ibid., p. 465.

[24] Ibid., p. 468.

[25] Ibid., p. 469.

Huttonianism."[26] As Playfair was the dominant advocate of Huttonianism, his views on the relationship between the deluge and geology were evidently of interest to Buckland. It is probably no coincidence that the compilation of Buckland's major work in support of the diluvial theory would be called *Reliquiae Diluvianae*, "relics of the deluge," and would feature evidence for precisely the same two vestiges of the deluge that Playfair had conceded were possible. While Playfair had believed the diluvial marks would vanish, Buckland argued that the bones and mud could be preserved in caves that would have prevented them from being consumed or washed away.

Buckland's earliest work already displayed many of the characteristics that would distinguish his geology throughout his career. His acceptance of the physical evidence of a deluge, his correlation of distant formations, his extensive use of fossil evidence, combined with stratigraphic studies and mineralogical analysis, were all developed very early on, and demonstrated in his first major paper. His general style of presentation was very unsystematic, and it was often left to his critics to try to give some kind of rationalized sequence to his research.[27]

In the summer of 1814, Buckland studied the tertiary strata near Reading in southern England and followed the subsequent spring with an examination of the London basin near Woolwich, accompanied by William Conybeare. The resulting paper,[28] read before the Geological Society in January 1816, began with the usual stratigraphic descriptions that were common to the papers presented to the Society at the time. In Reading, Buckland had identified and described thirteen distinct formations from the gravel on the surface down through the tertiary strata to the chalk. One formation, found immediately above the chalk and beneath the London clay, was particularly interesting. After providing an account of the deposition of this formation, Buckland compared it to a formation at Woolwich and discovered that, although there were differences between the two, the general mineralogical character of the formations, and the identical organic remains found in both, left "no doubt as to their being members of one great series, of nearly contemporaneous depositions."[29] Buckland joined the two formations with ones that had been described by other geologists into one continuous series across southern England. This synthesis of local evidence indicates a strategy that Buckland would use repeatedly in his geology. Local studies were central to Buckland's methodology, as his student Charles Lyell reported in a letter describing the lectures he attended at Oxford:

> Buckland...is quite of White's opinion 'Local information from actual observation tends more to promote Natural History & Science than all that is done by the speculation and compilations of voluminous Authors.'[30]

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[26] Gordon (1894), *The Life and Correspondence of William Buckland*, p. 14.

[27] For example, Fitton's review of *Reliquiae Diluvianae* for the *Edinburgh Review*, 39(1823), pp. 228-229.

[28] "Description of a Series of Specimens from the Plastic Clay near Reading," read January 6, 1816, *Trans. Geol. Soc.* 4(1817): 277-304.

[29] Ibid., p. 283.

[30] Letter from Charles Lyell to his father, dated July 28, 1817. Quoted in Wilson (1972), *Charles Lyell: the Years to 1841*, pp. 48-49. Lyell Sr. wrote that Buckland's lectures were

But, even though Buckland began with local information and developed systematic local analyses, his goal was usually to produce conclusions that had an impact beyond the given localities, usually leading toward universal consequences.

A comparison of the Reading sequence with the work of Cuvier and Alexandre Brongniart[31] convinced Buckland that what he had found in England was identical to a formation that had been found in France and was known as the plastic clay (*argile plastique*). Buckland again developed a hypothesis of the continuity and contemporaneous deposition of a series of strata based on the similarity of their appearance and position, and on the identical remains of molluscs found in similar strata in the French and English formations.[32] This reconciliation of local geological sequences with those of continental Europe was almost unique in Britain at the time, although Werner had advocated the possibility of a universal stratigraphic table based on mineralogical properties at the end of the previous century.

Even though the correlation of English and continental formations was original, Buckland's work toward standardized sequences was still firmly within the descriptive tradition of the Geological Society, where Wernerian stratigraphy dominated the earliest papers of their *Transactions*. But Buckland continued beyond the stratigraphical outline and found in the plastic clay formation near London evidence that much of the strata of chalk had been destroyed by a violent rush of water. An immense number of rounded chalk flint pebbles were contained in the strata of the plastic clay immediately above the existing chalk and from this evidence, and Buckland concluded that the pebbles had initially been part of the chalk strata and were torn from there by the force of massive "aqueous destruction."[33] The extent of this destruction was not specified, but Buckland cited the similar conclusion drawn by Cuvier and Brongniart from their work around Paris, suggesting a force that was something more than a merely local phenomenon. In this his first significant paper, Buckland had expanded his work from a careful description of the strata at Reading into the hypothesis of a wide ranging flood, although at this point he was only providing a hint of what was to follow.

Most of the development of Buckland's diluvial theory took place in the five years between his appointment to the new position of Reader in Geology at Oxford in 1818[34], and the publication of *Reliquiae Diluvianae* in 1823. The advances made use of evidence from three key areas: first, the gravel, loam and general drift found throughout the world that were the traditional basis of diluvial theories, but with the additional analysis of the organic remains they were found to contain; second, the form and structure of what Buckland called "valleys of

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engaging his son "heart and soul" at that time, Ibid. p. 44.

[31] G. Cuvier and A. Brongniart (1808), "Essai sur la géographie minéralogique des environs de Paris" *Annales de Muséum d'Histoire Naturelle*, 11: 293-326

[32] Buckland (1817); the connection between the *argile plastique* and the British Plastic Clay was later disproved, Sedgwick (1831), p. 294.

[33] Ibid. p. 301.

[34] In the published versions of his papers delivered after 1819, Buckland was always given the title "Professor of Geology and Mineralogy," but his actual appointments were readerships in those two fields.

denudation" where sections of horizontal strata had been removed; and third, the bones and mud found in caves throughout Europe. In Buckland's opinion, all of the evidence indicated a deluge that was, unlike Cuvier's last revolution, a contemporaneous universal event that was both recent and transitory.

Even before Buckland had carried out much original research, there was a considerable amount of physical evidence uncovered by such researchers as Deluc, Catcott, and Greenough that Buckland could summon to support the diluvial theory. This conventional evidence for a recent deluge was presented in a 9-point summary by Buckland in his Inaugural Lecture as Reader in Geology, delivered May 15, 1819 and published as *Vindiciae Geologicae* (1820). In this summary, Buckland already displayed his concern for justifying a theory of a single universal deluge. Buckland listed as types of evidence the "universal modification" by water of the sides and surfaces of hills, analogous to the effects presently seen produced by rivers, the "universal confluence" of minor valleys, and the deposits of gravel found on the summits of hills and "universally in valleys over the whole world."[35] Buckland acknowledged that explanations for these phenomena that relied only on existing or recent causes would be preferable, but that was, in his opinion, a "total impossibility."[36]

The most that any series of observations could demonstrate was that each area indicated the previous activity of a flood, which would suggest a succession of deluges, with similar effects throughout the districts that had been investigated – at this time still primarily restricted to parts of Europe. Buckland, however, never seems to have given much consideration to any form of a deluge other than a single universal event. He justified this conclusion in his Inaugural Lecture by citing the similarity of the evidence in all locations:

> VIII. The analogous occurrence of similar phenomena in almost all the regions of the world that have hitherto been scientifically investigated, [present] a series of facts that are uniformly consistent with the hypothesis of a contemporaneous and diluvial origin.[37]

Buckland's claim that the evidence indicates a *universal* flood could never be established by observation, since it is impossible for observations to be of anything other than local detail. Universal phenomena cannot be observed, they can only be supported inductively, based on similarities of local observations. This was the method that Buckland would consistently apply in his original research: detailed local studies, correlated with observations from distant locations to lead to a universal conclusion.

Buckland's first significant original contribution to the diluvial theory was his account of the quartz pebbles beds found in central England and his description of the formation of the valley of the Thames.[38] In the summer of 1819, two months after delivering his Inaugural

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[35] Buckland (1820), *Vindicae Gelogicae*, p. 37.

[36] Ibid., p. 38.

[37] Ibid.

[38] Buckland (1821), "Description of the Quartz Rock of the Lickey Hill in Worcestershire...with considerations on the evidences of a Recent Deluge...and an Appendix, containing analogous proofs of diluvian action. Collected from various authorities," *Trans. Geol.*

Lecture, Buckland travelled to Lickey Hill to study the local strata of quartz. The hill, located near Birmingham, had been mentioned by John Kidd, Buckland's former professor and predecessor at Oxford, as the possible source of the quartz pebbles found in Oxford and surrounding areas. From this trip to Lickey Hill, Buckland produced a very ordinary, descriptive paper attached to which, however, was perhaps the most astonishing work he ever produced: an emphatic declaration of the universality of the deluge based, again, on a detailed study of local phenomena and an account of the changes that had occurred in a single location: in England between Oxford and London.

Buckland agreed that the quartz pebbles found throughout Oxford and Warwick had originated in a line of quartz rock which had previously formed a continuous chain, of which Lickey Hill was one of the few survivors. To account for the distribution of the quartz pebbles, Buckland produced one of his customary "histories." He proposed that the quartz had been broken down and rounded into pebbles by the actions of an "extensive and violent" inundation which occurred **long before** the last universal deluge.[39] Over a lengthy period, these pebbles were subsumed by the New Red Sandstone as it was deposited. They remained in the New Red Sandstone for another very long tranquil interval until they were torn up by "the waters of the last deluge" which spread the pebbles over the midland plains. These quartz pebbles were presently found on the summits surrounding the valleys through which the Thames and Evenlode now flow, and this implied to Buckland that the pebbles must have been distributed before the valleys were excavated. Since the deluge, which carried the pebbles, was the last event to greatly modify the surface of the Earth, Buckland concluded that the valleys must have been excavated by its **retiring** waters. In his "history," there was initially a great current from the north-east, which tore up the New Red Sandstone formation around Lickey Hill and then, carrying the quartz pebbles, deflected off a range of ridges into a south-east direction through the areas now occupied by the valleys of the Evenlode and Thames, spreading the pebbles throughout. After the pebbles had been distributed – how long after is never specified – the retiring waters then destroyed the oolite strata and excavated much of the valleys, which accounted for the finding of oolite debris in the valleys. This deluge, Buckland claimed, was the same "aqueous destruction" he had described in his paper on the plastic clay formation.

Buckland categorically affirmed that diluvial effects just like the ones he detected in Britain were found over the entire Earth. Going well beyond any possible evidence, he declared that "traces of diluvian action are most unequivocally visible in the features of every valley of the earth,"[40] and that there were "similar contemporaneous systems of valleys which occur on strata that are similarly circumstanced in every part of the world." Buckland did not believe that all valleys were solely excavated by the deluge: fractures, elevations, subsidence and other causes could all have left some modifications in the surface, but even in these cases the deluge had swept over and added the final touch. The implication was clear: the event that Buckland had described – in only one location – was worldwide, leaving the same consequences in its wake wherever observations had been made.

Soc. 5: 506-544. Read December 3, 1819.

[39] Ibid., p. 528.

[40] Ibid. p. 524.

Obviously, this was not the result of a force anything like those presently existing. Buckland had applied an actualistic comparison of the distribution of gravel caused by the bursting of an alpine lake ("alluvium") with the "diluvium" of the deluge, and used the similar results to support the theory of formation by water.[41] However, he maintained that after careful examination the post-diluvian alluvium was always distinguishable from diluvium and therefore there was a real, verifiable geological discontinuity at the time of the deluge. No local actual causes could ever account for either the deposits of diluvium, found "universally and contemporaneously not only over the district under consideration but over the whole earth," or the excavation of valleys, which indicated a force "infinitely more powerful" than what was observed from even the most violent existing causes.[42]

Organic remains found in the diluvium were employed by Buckland to supported his timing of the deluge. Samples from across Britain and elsewhere had undergone no mineralization, supporting the hypothesis that they, and consequently the flood that buried them, were **recent**. They also showed few signs of being rounded, suggesting the deluge had been **transitory**, not lasting long enough to shape the bones. The fauna found in the diluvium, particularly the mammoth and rhinoceros, were generally the same in all areas, consistent with the premise that the flood had **contemporaneously** effected the entire Earth.[43] This last argument from organic remains received little emphasis from Buckland, and was certainly the least convincing. Assuming that the population of the earth was consistent in all locations, inundations acting locally would also have produced the observed effects. Buckland, however, believed the similarity of animals found in the diluvium of all areas pointed to a distinct and geologically brief period. If the inundations were local, they must all have occurred within such a limited time span as to be indistinguishable from a single event.

There is some question that Buckland really believed in a strictly simultaneous deluge. His critics, like William Fitton, used the word "simultaneous" to describe Buckland's geological flood, but he did not use it his own writings, where "contemporary" was preferred.[44] Traditionally, the words had both been used to mean "at the same time," but the OED finds that geologists of the early nineteenth century[45] gave "contemporary" a new meaning: "at the same period," which is another phrase Buckland used to describe the deluge. The effects Buckland assigns to the retiring waters of the deluge suggest that he believed this water kept in violent motion over the entire event, resembling more a pair of tidal waves in opposite directions than a single flood. This would partly support the claim made by Fitton[46] that at least Buckland's description of this flood as "contemporaneous" was influenced by concerns with making the geological flood sound more like the Biblical than it really was. Exactly what duration the flood occupied from beginning to end is never addressed by Buckland, and if we interpret

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[41] Ibid., pp. 530-531.

[42] Ibid., p. 523.

[43] Ibid., pp. 534-537.

[44] Buckland did use "simultaneously" once: Buckland (1822), p. 224, but even here his description is consistent with the "same period" interpretation.

[45] The first instance of this usage given in the OED is by Charles Lyell in 1833.

[46] Fitton (1823), p. 230.

"contemporaneous" within geological periods, it could be that he allowed a much longer duration than is generally assumed.

Buckland's original work in his Lickey Hill paper was followed by a lengthy compendium of carefully selected excerpts, primarily summaries of the observations of geologists, including Greenough, Cuvier, Catcott, DeSaussure and many others, designed not only to strengthen the inductive inference to a universal event, but also to suggest that the conclusions Buckland reached were at least partly accepted by some of the most able researchers. Each piece of this collection of evidence supported the theory that accumulations of diluvium were recent, and so similar in all respects that "it is impossible not to refer them to one and the same common cause, viz. a recent deluge acting universally and at the same period over the surface of the whole globe."[47] This research, which was later reproduced in the *Reliquiae Diluvianae*,[48] was the strongest statement of universality found in any of Buckland's writings.

The most significant chapter in the development of Buckland's diluvialism was his development of an entirely new category of evidence to support the theory of a deluge. Buckland called his cave studies "one of the most complete and satisfactory chains of consistent circumstantial evidence I have ever met with."[49] The centrepiece of this development was Buckland's examination of Kirkdale Cave. In July of 1821, quarrymen working in Yorkshire had accidentally come upon a cave in the limestone filled with an immense number of fossil teeth and bones. The bones were largely thrown on the roadside by the workers who thought they were the remains of cattle, but a local doctor happened to take samples, a few of which ended up in the hands of researchers like Buckland, who received a small collection in November. Before Buckland ever visited the area, and within a week of having obtained the specimens, he had already come upon the solution to the confused mixture of many different animals that was found in the single cave.

The large quantity of hyena remains convinced Buckland that the cave had been a hyena den, and he concluded that the other animals found in the cave could have been caused in two ways:

> either the wreck of the Hyaena's Larder, or were drifted into a fissure by the Diluvian Waters; both are possible causes, but the latter assumes that there was a fissure open at the top...we can only suppose the Bones to be the wreck of Animals that were dragged in for food by the Hyaenas[50]

When Buckland visited the cave the following month, he gathered additional samples that all seemed to confirm his hypothesis. Twenty-two species were found in Kirkdale Cave, including hyena, elephant, rhinoceros, hippopotamus, horse, tiger, bear, wolf, fox, weasel, rabbit, ox, deer, water-rat and several birds. Almost every bone recovered had been broken, and many

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[47] Ibid., p. 544.

[48] In abridged form, pp. 249-258, but with all of the references to universal diluvial effects maintained, and in fact emphasized by being moved from a lengthy footnote in the original paper into the main body.

[49] Buckland (1822) "Account of an Assemblage of Fossil Teeth and Bones," *Phil. Trans. Royal Soc.*, 62: 171.

[50] Letter from Buckland to Jane Talbot, November 26, 1821. Quoted in North (1942), p. 97.

of them had marks which fit the form of the hyena teeth found in the cave.

From the volume of bones found, Buckland concluded that the cave must have been inhabited by hyenas for a long period of time, during which the bodies of the other animals that were found were dragged in by the hyenas to eat in their den. This conclusion was strengthened by the finding of small spheres that were revealed by chemical analysis to be consistent with the composition of the faecal matter of bone-eating animals, known as *album græcum*.[51] When Buckland compared the eating habits of these ancient hyenas to those described in accounts of existing species, he found that existing hyenas had been observed to eat bones and drag their prey. He later was able to observe first hand the habits of a living hyena when one came to Oxford with a travelling collection, and found that the animal did crack bones fed to it to get at the marrow, leaving marks identical to those on the Kirkdale bones.[52] There was still some scepticism that hyenas would show the restraint to carry their prey and not eat it,[53] and it was several years until the first observations were made of existing hyena dens which were found, as Buckland predicted, to contain the bones of carried off prey.[54]

To explain the cave remains, Buckland could conceive of only two possible alternatives to his hyena den theory, both of which involved a deluge. First, the animals could have been seeking shelter from the deluge, but the presence of animals the size of the elephant and rhinoceros in a cave that was only three feet across in some places made this impossible, and it seemed inconceivable that even the smaller animals would all live together in a single cave. The second alternative was that the animals could have been drifted into the cave by the waters of a flood, but this still left the problem of the large animals whose entire bodies could not have fit in the cave, and the smaller animals were in such great numbers that all of their bodies would also not have fit. Buckland rejected the two explanations that involved a deluge in the appearance of the bones and maintained that the bones had accumulated gradually when Kirkdale Cave was an ancient hyena den and when the hyenas and all the other animals were inhabitants of Britain.

The non-catastrophic account of the placement of the bones in the cave was not popular among "scriptural geologists" such as Granville Penn and George Young who supported the "drift" explanation and attacked Buckland's work as incompatible with scripture.[55] Buckland's account also seemed contrary to the title of the book from which it received its widest audience. The bones were not "relics of the deluge," but gradually accumulated remains of hyena prey.[56] But the title is not misleading, and the bones *as discovered*, though not as originally placed, are

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[51] Buckland (1822), p. 186.

[52] Buckland (1836), *Reliquiae Diluvianae*, pp. 37-38.

[53] e.g., Fitton (1823), p. 211; Fleming (1826), pp. 231-232. Fleming was incredulous that hyenas would carry bite-sized animals like rats and pigeons back to their den.

[54] Buckland (1827), Letter to Robert Jameson containing letter to Buckland from Captain W.H. Sykes in Poona, India. *Edinburgh New Phil. Journ.*, 2: 377-380. Published in response to Fleming's criticism in the same journal the previous year, see above note.

[55] Boylan (1967), p. 241; Rupke (1983), pp. 42-50

[56] Rupke (1983) judges the title to be a misleading disguise or apology for the supposed non-catastrophic conclusion, p. 39.

relics of the deluge. Playfair, when asking for "monuments of the deluge" had concluded that all evidence would be washed away, and Buckland generally agreed with that conclusion. But he believed he had found an exception:

> so completely has the violence of that tremendous convulsion destroyed and remodelled the form of the antediluvian surface, that it is only in caverns that have been protected from its ravages that we may hope to find undisturbed evidence of events in the period immediately preceding it.[57]

Signs of the deluge were present in the cave, in the layer of mud in which the bones were found. Buckland could see no alternation of mud with bones or stalagmite – only one single layer, and concluded that it was the waters of a single flood that had introduced the mud and furthermore that it was probably the same flood that was responsible for the production of the diluvial gravel.[58] Based on this "probable" association of the mud with the deluge, and the well-preserved condition of the bones, Buckland concluded that the animals of the cave had existed immediately before the deluge. This was a very weak argument, and in opposition to Buckland's conclusion, Fitton claimed that there was "unquestionably no evidence as to time" in the Kirkdale remains.[59]To support his conclusion that existing causes could not account for the mud, Buckland described his first visit to the cave "at the end of one of one of the most rainy seasons ever remembered" at which time he found not a trace of mud entering the cave.[60] But Buckland had also suggested that the valley near the cave had been the site of an ancient lake, and it seemed more reasonable to Fitton and other critics to assume that this was where Buckland should have looked for a source of the mud, and that his supposed actualistic argument ignored to its advantage the very changes Buckland believed had occurred locally. The single mud layer was covered with stalagmite, which indicated that many years had passed since the mud was deposited on the cave floor. In Buckland's opinion, a deluge would also explain the absence of any discovery of the intact final residents of the cave: they would have rushed out and "fled for safety to the hills."[61]

Buckland's assertion that the flood was responsible for only a mundane layer of mud and not for the extraordinary collection of bones may be interpreted as diminishing the perceived effects of the flood in that one instance, but the *Reliquiae* also contained Buckland's research on valley formation which, as previously described, ascribed to this deluge not only the modification of all valleys on the face of the earth, but also the creation of the valley of the Thames and even the English Channel.[62] Each section of the *Reliquiae* contained, in Buckland's

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[57] Buckland (1822), p. 202; Buckland (1823), p. 42.

[58] Ibid., p. 207.

[59] Fitton (1823), p. 214.

[60] Buckland (1823), p. 50.

[61] Buckland (1822), p. 199.

[62] On the last effect, see *Reliquiae Diluvianae*, p. 246, and Buckland (1824), "On the Excavation of Valleys by Diluvian Action," *Trans. Geol. Soc.*, 1: 101. Read April 19, 1822.

interpretation, precisely what the title indicated: relics of a deluge, and the cave remains had the additional force of being compatible with Playfair's own description of what form these relics could possibly possess.

Analogous phenomena to those found in Kirkdale Cave were also discovered in other British caves, and in caves in Germany which Buckland had visited with Greenough in 1816, and revisited while preparing the *Reliquiae* in 1822. The German caves provided Buckland with "a harmony of circumstances exceeding what my fullest expectations would have anticipated," with a similar deposit of mud uncovered in every cave that was examined.[63] The assignment to the British and German caves a common time was based primarily on the similarity of paleontological evidence and not on the common finding of mud and stalagmite. The extinct species of rhinoceros, elephant, hippopotamus, and others were common to both caves and gravel beds, and on the assumption that these animals inhabited these regions in a single time period only, Buckland concluded that they lived prior to the distribution of gravel, for which he could see no other explanation than a universal deluge.[64]

The reviews of Buckland's cave research, along with his other evidence for the diluvial theory as it appeared in the *Reliquiae Diluvianae* were generally very approving. Edward Copleston wrote a highly favourable critique for the *Quarterly Review* which gave Buckland credit for three important original contributions: first, Buckland had refuted the conventional diluvial theory of Deluc and Cuvier which maintained that the land and sea had changed place at the last revolution; second, Buckland had shown that the remains of tropical fauna that were found in diluvium in northern climates had been native to those temperate regions and were not drifted from remote areas; and third, Buckland had been able to describe the lives of animals prior to the deluge, which had previously "presented an impassable barrier to all the researches of the naturalist."[65] Copleston's review was entirely commendatory toward Buckland's work, saving its wrath for the actualist theories of Hutton and Playfair which were judged "too monstrous an outrage upon common sense to be treated without ridicule."[66] It seems to have been generally accepted, however, that Copleston and Buckland had collaborated a bit more than propriety would permit in the writing of the review. Seven years later, when Lyell's *Principles of Geology* was being reviewed by Scrope, Lyell reminded Scrope not to consult him:

> I might get in as great a scrape as Buckland when he concocted with Coplestone a review of his own Reliquiae Dil. which is still never forgotten against him & not without reason.[67]

An American review by another of Buckland's friends, Benjamin Silliman[68] was as enthusiastic

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[63] Buckland (1823), p. 108.

[64] Buckland (1822), p. 224.

[65] Copleston (1823), pp. 156-157.

[66] Ibid., p. 142.

[67] Letter from Lyell to Scrope, May 6, 1830. Quoted in Wilson (1972), pp. 273-274.

[68] Page (1969) identifies the writer as Edward Hitchcock, Silliman's colleague who was also a friend of Buckland's.

as Copleston's, and seems to have taken many of its points directly from that previous review, including the same three claims of the novelty of Buckland's work.

The report of Kirkdale Cave was read to the Royal Society in February, 1822. It was the only paper Buckland ever presented to that body, and Rupke has suggested that this was because they had published some earlier cave research by Everard Home, the conclusions of which Buckland opposed in his compilation of previously discovered "analogous" phenomena.[69] In November of the same year, Buckland was presented with the Copley Medal by Humphry Davy, President of the Royal Society, who had visited Kirkdale Cave with Buckland during the summer. In a letter, Buckland wrote that this endorsement would put a halt to any serious resistance to his theory:

> the President and Council of the R.S. have sanctioned my paper with the Copley Gold Medal, so that I am now not much afraid of any further opposition to my Hyaena story, which my friends at first predicted no body would believe a word of it.[70]

There still was some opposition, but for the most part, for the two years after the approval of the Royal Society, Buckland's "Hyaena story" did escape any serious opposition. That is, it was accepted that hyenas and the other animals were ancient natives of Britain, and that Kirkdale Cave was a hyena den. What did not avoid criticism was Buckland's continued implication that geology was providing support to revealed religion.

Buckland's advancement of ideas that provided scientific support to the reality of the Mosaic deluge disappointed some supporters of science, as well as religious fundamentalists. Many geologists wanted a science that operated with complete independence from revealed truths and other written records. It was fine to show evidence in support of a physical deluge, but as Fitton advised, "the physical part of the inquiry ought to be conducted as if the Scriptures were not in existence."[71] To Copleston, this was "a symptom of prejudice against religion." He saw geologists as a new type of historian, and for these historians to ignore the records of tradition made no sense – it was nothing less than choosing to overlook significant evidence, a choice which could only detract from their accounts.[72]

Ironically, despite all his claims that he was a "reconciler," Buckland's actual methods were more in accordance with Fitton's belief in an independent science than with the integrated proofs from tradition and physical evidence advocated by Copleston. Whenever he presented evidence in support of the diluvial theory, Buckland respected the separation of geological observations from the testimony of revealed religion. None of his geological papers refers to the Biblical account of the deluge[73], and even the *Reliquiae Diluvianae* only links the geological

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[69] Buckland (1822), p. 214.

[70] Letter from Buckland to Lady Mary Cole, December 22, 1822. Quoted in North (1942), p. 103.

[71] Fitton (1823), p. 198. Moore (1986), not knowing the original source, marks the emergence of professional geology with Lyell's adoption of this edict in 1832, pp. 337, 348 n. 22.

[72] Copleston (1823), pp. 138-142.

[73] Although it seems clear that Buckland personally believed the universal deluge he was describing was the Noachian flood, he never actually stated this directly in any of his writings.

conclusions to the Bible in the dedication to the Bishop of Durham. Even here, however, Buckland made it apparent that he was motivated to make this connection by a desire to show how geology could be combined "with those branches of study which are more strictly academical" and take a legitimate place within the traditional learning at Britain's universities.[74] Rupke has argued that an understanding of the Oxford background is crucial to any account of Buckland's geology[75], but we must be cautious about placing too much emphasis on this context. To find the centre of Buckland's geology we should not look to Oxford, where he was an isolated figure who seldom involved himself in university affairs, but instead to London and the meetings of the Geological Society. The claim that Buckland's diluvial theory represents an "adjustment" of geology to conform to Oxford traditions ignores the fact that the principal audience for Buckland's research was geologists, primarily of the Geological Society[76], but also of the French Société Géologique and other international institutions. The Royal Society's presentation to Buckland of their most distinguished tribute, the Copley Medal (1822) – the first ever awarded to a geologist[77] – demonstrates that his work successfully spoke to the intended audience.

It is no surprise that Buckland used his Inaugural Lecture to justify the presence of geology within Oxford, but this emphasis is almost unique among his published work. Buckland used the rhetoric of reconciliation to support his geological lectures at Oxford, but in practice, his geology was not tied to Biblical events. Even in the Inaugural Address, Buckland supported the independence of science by defending the view that the Bible was not to be read for scientific instruction, but only for moral and religious guidance. The universal deluge he believed was uncovered by geological evidence bore little resemblance to that in scripture, as detractory Fundamentalists like Penn and Young were quick to point out. Less extreme critics also found the differences apparent. An outraged anonymous correspondent to the *Philosophical Magazine*[78] who had read *Vindiciae Geologicae* (1820), the published version of Buckland's Inaugural Address, stressed this point:

> the Professor must, by the *examination of Moses' words*, have found, that the same, throughout, refer to *a quiet effusion of Water upon the surface of the Earth*,

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The best evidence that he did identify the two events is in his expectation that human remains may eventually be found in the diluvium, despite the absence of any geological reason for believing that the flood must have occurred after the appearance of human beings. *RD*, 170.

[74] Buckland (1823), iii-iv.

[75] Rupke (1983), *The Great Chain of History*.

[76] These were, for the most part, the same geologists who formed the geological sections of the British Association and the Royal Society, which were also key audiences for Buckland.

[77] And, as David Brewster later pointed out in his "Observations on the Decline of Science in England," the first and only such award given to a university professor, *Edinburgh Journal of Science* 5(1831): 3-4.

[78] Page (1969) identifies him as John Farey, a student of William Smith who was a regular commentator on geology for the *Philosophical Magazine*, but other researchers do not confirm this. The correspondent does refer to Farey's work, *Phil. Mag.* 56(1820): 10-14.

> for the avowed purpose and for no other, but that of *drowning the degenerate race of Mankind*, ...and that in point of fact, *according to Moses, the surface* of the Earth, was not torn up or moved... Whereas the Gravel Floods which the Professor has laboured to identify with this Noachian Deluge, must, undoubtedly, have left the entire surface of the earth, *as utterly unfit for immediate reception and support of Men*.[79]

The very evidence that was the foundation of the diluvial theory: the universal occurrence of detritus, is here used against the possibility of connecting this "Gravel Flood" with that of the Bible. The correspondent further asks where the remains of humans are to be found in the diluvium, an anomaly that Buckland could explain away in the first half of the 1820s, but which, as more areas were explored, made it increasingly difficult to harmonize the timing of the geological deluge with that of the Bible.

In spite of Buckland's rhetorical claims of Biblical support, his actual geology had little to do with revealed religion. The most capable theologian among the advocates of the diluvial theory was William Conybeare, to whom was often left the task of defending diluvialism from Fundamentalist or uniformitarian critics.[80] Buckland seldom published any explicit discussion of the relationship between geology and religion,[81] but we can find a clue to what Buckland may have thought in Conybeare's writings. When he enlarged William Phillips's popular stratigraphic text *Outlines of the Geology of England and Wales* in 1822, Conybeare added a long introductory "Compendium of the General Principles" of geology, presented as a fundamental summary for those who were unfamiliar with the field. Although he claimed that his focus would be to record facts and not to propose theories, he immediately launched an attack on both Wernerians and Huttonians, particularly on the latter school's insistence that gradual, existing causes were sufficient to explain the present surface of the earth.[82] As Lyell would do in his *Principles of Geology* (1830), Conybeare presented a history of geology in which his opponents were portrayed as "zealous partisans" observing the world "through the medium of a preconceived hypothesis."[83]

Like Greenough before him, Conybeare found his professed general scepticism of theories to be no barrier to the acceptance of the diluvial theory as a necessary inference from the mass of observed evidence. He believed that the evidence from drift and valley formation established that there was a recent "great and universal catastrophe," and cited Buckland's recent cave studies and several older works in support of this claim.[84] On the central question of the

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[79] Ibid., p. 11.

[80] e.g. his lengthy response to Lyell's *Principles*, "An Examination of those Phenomena of Geology which seem to Bear most Directly on Theoretical Considerations," *Phil. Mag.*, 8(1830): 359-362, 401-406; 9(1831): 19-23.

[81] The two exceptions were his Inaugural Lecture (1820), and his Bridgewater Treatise (1836).

[82] Conybeare and Phillips (1822), xxii-xxiii.

[83] Ibid., xlvi.

[84] Ibid., xxviii-xxxi.

relationship between geology and religion, Conybeare made it clear what kind of association could be expected between the two. As Buckland had stated in his Inaugural Lecture, Conybeare stressed that the object of Revelation was the relationship between God and human beings and "the dealings of Divine Providence." Geology and the other physical sciences were largely independent of such implications.

> The general connection of physical science will therefore be rather with natural than revealed religion; for in the former the great problem is to trace the Author of Nature in his works, and our interest in the evidences thus furnished is materially (as we have seen) kept alive by their being made the matter of gradual and successive discovery, so that the mind is continually presented with *fresh* proofs, extending as its general knowledge extends.[85]

To demonstrate the connection between geology and natural religion, Conybeare included a five-page excerpt from Buckland's Inaugural Lecture.[86] Geology does provide evidence of a universal flood, but Conybeare argued that the support this may give to revealed religion is indirect. The significance of connections between the geological flood and that in the Bible was not that geology proved the reality of Noah's flood, but only that it demonstrated that such events were possible by revealing that a universal deluge had in fact occurred.[87] Beyond this indirect correlation, Conybeare asserted that the association of geology with religion was strictly in its support of natural religion, and the confirmation it provides of God's benevolence and wisdom.

Another of the important supporters of the diluvial theory was Adam Sedgwick, Buckland's counterpart at Cambridge, and a fellow member of the close circle of elite members of the Geological Society.[88] Two years after he joined the Geological Society in 1816, Sedgwick was appointed Woodwardian Professor of Geology, and was soon defending the geological demonstrations of "a great diluvian catastrophe during a comparatively recent period in the natural history of the earth."[89] These demonstrations were independent of scripture, but Sedgwick defended Buckland from the Fundamentalist criticism that he had degraded scripture connecting it to the "speculations of science."

> Between these conclusions, derived from sources entirely independent of each other, there is, therefore, a general coincidence which it is impossible to overlook, and the importance of which it would be most unreasonable to deny. The

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[85] Conybeare and Phillips (1822), li.

[86] Ibid., li-lvi.

[87] Ibid, lvii.

[88] Sedgwick was also a close friend of Buckland. In June 1838, William and Mary Buckland named their newborn son Adam Conybeare Sedgwick Buckland, Clark and Hughes (1890), *Life and Letters of Sedgwick*, p. 511. Conybeare and Sedgwick were also friends: it was Conybeare who guided much of Sedgwick's early work in geology.

[89] Quoted in Clark and Hughes (1890), p. 292, from Sedgwick (1825), "On Diluvial Formations," *Annals of Philosophy*, 10: 18-37.

> coincidence has not been assumed hypothetically, but has been proved legitimately, by an immense number of direct observations conducted with the indefatigable labour, and all tending to the establishment of the same general truth.[90]

It was philosophically sound, Sedgwick argued, to associate the two accounts of a deluge because all truths, however determined, must support one another. Accordingly, Sedgwick could accept both Buckland's general conclusions and his methods, both scientifically and theologically, but Sedgwick did not commit to a universal deluge. He accepted that there was good local evidence that a rush of water had swept over "different parts" of England, "some parts" of Scotland, and "many parts" of northern Europe, but Sedgwick did not make the inductive jump from local evidence to a single global flood event.

Like most British geologists of this period, Sedgwick did not focus his research on uncovering proofs of a deluge. Most of the work performed by members of the Geological Society continued to be stratigraphal studies, with an emphasis on tracing formations throughout Britain and developing a reliable order of succession among the strata. But the language of the diluvial theory, particularly the use of the word "diluvium," became common in papers read before the Society, and the diluvial theory had won the support of many of its leading members. The presentation of the Copley Medal to Buckland in 1824 indicates the respect that his work received as exemplary science. Two years later, his position as one of England's elite geologists was confirmed when he was elected to his first two-year term as President of the Geological Society. While it was widely accepted that signs of some form of deluge were evident, where Buckland went beyond many of his colleagues was in his belief that this evidence indicated a unified universal flood, and not a succession of local events. Fitton had already subtly suggested that this may reflect the influence of the scriptural account of the flood, and this claim was developed by other critics in the late 1820s.

Criticism and counter evidence, 1825-1830

In the second half of the 1820s, the diluvial theory was the target of two major attacks which brought into question the reality of what Whewell called "the discontinuity which separates us from former creations."[91] Both of these attacks were lead by members of the revitalized uniformitarian school who opposed Buckland and others' claims that existing causes were inadequate to account for observed geological features. The central figures in the attack on the diluvial theory: John Fleming, George Poulett Scrope, and Charles Lyell, also had in common a resentment toward the association of geology with scripture. Correspondence between Scrope and Lyell reveal that they believed they were bringing about a new era in geology by eradicating the "doctrine still supported by the Bucklands, Conybeares etc." and "freeing Geology, once and forever from the clutches of Moses."[92]

The customary exemplar of uniformitarianism is Lyell, but the Scottish Presbyterian

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[90] Ibid., p. 293.

[91] Whewell (1831), Review of Lyell's *Principles*, *British Critic*, 9: 193.

[92] Letter from Scrope to Lyell, June 11, 1830. Quoted in Wilson (1972), p. 275.

minister John Fleming may have been its most ardent defender. Fleming was a member of Jameson's Wernerian Natural History Society, and in the early 1820s he became a well-known critic of geology for several Edinburgh-based publications. His reviews included strongly worded rebukes of the work of Greenough (1820) and Cuvier (1823), and he even criticized Jameson over his endorsement of Cuvier's theories in his notes to english translation.[93]

The primary focus of Fleming's work was the explication of the causes of extinction, and the refutation of the claim that organic remains provide evidence of a geological discontinuity in earth history. He believed that geologists had been led away from the best direction for research by placing too much emphasis on older rocks, by which Fleming meant anything from Buckland's "antediluvian" period. By choosing the older rocks as a starting point, Fleming believed geologists were led into speculations over an obscure point in history that would not have been necessary had they chosen to concentrate on the most recent formations, and developed their ideas around existing causes.[94]

Buckland's alluvium/diluvium division was one of Fleming's key targets, but he also criticized many other parts of Buckland's geology. The inference Buckland had drawn of a change in the climate of the Earth from the existence of now strictly tropical animals in ancient Britain was dismissed by Fleming as the result of an inadequate distinction between species and genera. Fossils of *genera* that were now only living in tropical areas were uncovered in Britain and other temperate regions, but these were not the same *species* currently existing, and the evidence indicated that the species found in northern areas were adapted to the colder climate. The finding of the hair-covered mammoth in Siberia demonstrated to Fleming, as it had to Cuvier, that there had been no change in climate in the arctic region.

The use of fossils to identify strata in distant locations was rejected by Fleming because it was non-actualistic: modern species are not distributed in the same formation in locations around the world, so it is inconsistent to expect that fossil species should be found in the same strata. Each location will have its own assembly of fossil animals, but there is no reason to expect the same assembly in similar but distant formations.[95]

On the central question of extinctions, Fleming looked at existing causes and concluded that the hunting habits of human beings must have effected great changes in animal distribution over their 6000-year history. Extrapolating to pre-human eras – and Fleming did accept that there was a long period of life on Earth before humans – he concluded that there had always been foes for the animals that existed, and this would have played an important role in their distribution. Another factor was changes in the Earth's physical condition brought about by the filling of lakes, the erosion of mountains and other long-acting gradual forces which are the "obvious tendency of the present order of things." These would have changed the condition of the environment and had considerable influence on the existing animals.

Some of Fleming's earlier writings actually show a train of thought similar to Buckland's. To account for the extinction of an entire race of animals, in his *Philosophy of Zoology* (1822), Fleming describes a scenario that involved a great number of lakes located around the world all filling up at the same time, claiming that "the universality of many of these upfilling formations

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[93] Page (1969), pp. 269-271.

[94] Fleming (1824), p. 287; Fleming (1825), pp. 126-127.

[95] Fleming (1823), p. 115.

justify the supposition," an inference that would have fit comfortably into any of Buckland's writings.[96] The early Fleming even accepts that "the universal deluge of Noah, and the numerous local inundations...must have greatly contributed to produce changes in the animal and vegetable kingdom." Such ideas of a universal extinction, however, were quickly forgotten and never made their way into Fleming's work after the beginning of his dispute with Buckland in 1824.

Fleming's attack on Buckland consisted of three papers published in Jameson's *Edinburgh Philosophical Journal* between October 1824 and April 1826. Beyond the arguments contained within them of deficiencies in the diluvial theory, they are notable for being the only criticism to which Buckland ever published a response – a letter to Jameson that appeared after the second of Fleming's papers. The remarkable popularity of Buckland's *Reliquiae Diluvianae* provided the impetus for Fleming's criticism. The endorsement of Buckland's theories by the Royal Society must have greatly disappointed Fleming, because he strongly believed that Buckland had produced poor science that had been accepted only because of the supposed ties to scripture.[97]

At the centre of Fleming's rebuttal was the contention that there was no break between the kinds of organic remains found in Buckland's diluvium and those in the supposed post-deluge alluvium. Using museum specimens and previously published studies of the recent peat bogs and marl beds, Fleming found that the remains of Irish Elk and the horn of a rhinoceros had been uncovered in the marl, and a hippopotamus had been reportedly found under a peat bog. The remains of the same animals were also abundantly found in the diluvium, and if they could have survived the supposed deluge, then why not others? The formations in which these bones were found showed no signs of any great modification, leading unavoidably to conclusion that they had not been affected by a deluge.[98] Fleming maintained that existing causes, specifically hunting, had killed these animals. He believed it was too much of a coincidence that the specimens found were of the animals that would have been of the most interest to hunters. The assumption that ancient hunters were inspired to capture the same trophies as modern sportsmen may be taking the argument from existing causes to extremes, but to Fleming's uniformitarian philosophy, such extremes were preferred to any reliance on forces not now active.

Inconsistencies in Buckland's deluge were ridiculed by Fleming. Here was an event so powerful that it ripped apart granite formations and cut out huge valleys, and yet was apparently ineffectual in its other consequences:

> it so far respected British productions, as neither to have floated into the Atlantic the quadrupeds which it drowned, nor the boulders of chalk which it produced, but permitted them to remain in the neighbourhood of the place of their birth.[99]

The so called diluvium was, in Fleming's opinion, of such limited distribution and so variable from one location to another, that there was no basis for the deduction of universality from the evidence they provided. In the second of his three papers on the diluvial theory, Fleming went further and suggested that local events of the kind which were regularly seen in recent times,

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[96] Ibid., p. 120.

[97] Fleming (1824), pp. 288, 305.

[98] Fleming (1824), p. 297.

[99] Ibid., p. 299.

including the bursting of alpine lakes, waterspouts, and local inundations of the sea, could account for everything Buckland called diluvium.[100]

Not only had Buckland gone far beyond the evidence and produced bad science, claimed Fleming, but the flood he described shared very few characteristics with the Noachian. The entire effort to relate geology with scripture was attacked by Fleming as producing nothing but a "faithless auxiliary" of the kind that Bacon had long ago condemned.[101] This critique was expanded in Fleming's final paper into a lengthy point-by-point discussion of the divergences from scripture of Buckland's geological deluge: Buckland's deluge caused extinctions, the Biblical flood did not; Buckland's deluge was a violent current, the Biblical flood was a gentle rising of the waters; Buckland's deluge excavated valleys and transported gravel, but no mention is made of such events in scripture. The notion that these two floods were harmonized was ridiculous to Fleming, who now endorsed a quiet Biblical deluge. The tranquil event described in the Bible would not have produced any lasting marks, and none are seen.[102] If Buckland's deluge is true, "then must the Book of Genesis be blotted out of the records of inspiration."[103]

Buckland's response, published in the April 1825 issue of the *Edinburgh Philosophical Journal*, ignored Fleming's theological criticisms and concentrated on a discussion of physical evidence and methods. Why did Buckland respond to Fleming while all other critics were ignored? Several factors seem to have contributed to the decision. First, Fleming was one of the first respected geologists to criticize Buckland publicly. Fitton had pointed out some defects in the *Reliquiae Diluvianae* in his review, but his review was generally respectful and highly complimentary in some areas, without the severity of Fleming's blanket rejection, and responding to a reviewer has never been a seemly course. Most of Buckland's critics had been "scriptural geologists" like Granville Penn and George Young, whose attacks on Buckland centred on providing alternatives to his account of Kirkdale Cave and emphasizing how much he had strayed from scripture. Buckland never was disposed to engage in theological disputes, and the challenges to his "hyena story" could be ignored after the Royal Society declared their opinion. Second, Fleming was rejecting the diluvium/alluvium distinction that had been one of Buckland's most successful original contributions, and had become part of the British geological nomenclature. Most importantly, Fleming was questioning a part of Buckland's theory that the scripturalists had not, and was in fact the one aspect that Fitton had accepted: the universality of

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[100] Fleming (1825), p. 123. He also asked (1826: 228) how a geologist could determine whether bones were antediluvian or postdiluvian, and in Buckland's next two papers read to the Geological Society (November 17, 1826 and April 20, 1827), he described for the first time this test: place the tongue on the bone, if it adheres, the bone is antediluvian (Buckland, 1826: 3). This was apparently due to a loss of animal gelatine (Buckland, 1827: 22). Such an accidental process is unlikely to have impressed Fleming.

[101] Fleming (1824), p. 305. It was faithless not because it was false but because the entire concept of supporting scripture was nonsensical to the believer.

[102] Fleming (1826), p. 214. With some inconsistency, Fleming claimed that this agreement between what is predicted by the Bible and what is observed heightens his "respect for the authority of revelation."

[103] Ibid., p. 215.

the deluge.[104] That this was an important stimulus for Buckland is shown in the reply, where Fleming's single sentence on evidence against a universal deluge was dissected and discussed at length by Buckland.[105] Fleming apparently realized that universality was Buckland's greatest concern: his final paper, written after Buckland's reply, was unrelenting in its emphasis on how all of the physical evidence points to successive *local* inundations, each of which may have resembled a deluge in its area, but which was certainly not part of a single global event.[106]

Another motivation for Buckland's response was simply that he thought that Fleming's interpretation of the evidence from organic remains was either demonstrably wrong, or at least not counter to anything in the *Reliquiae*. The supposed findings of a hippopotamus and a rhinoceros horn in very recent formations were dismissed by Buckland as inferences from imprecisely identified locations. He conceded that the Irish elk, which was certainly found in diluvium, may also be found in post-diluvial deposits, but saw this as no problem for his theory: many animals were found in both, including other species of deer as well as the ox, horse, fox, wolf and several others that had "repeopled" Britain since the deluge.[107] Buckland never explained this critical process of "repeopling," leaving Fleming to ask derisively if he was referring to the Ark, and if so, why were some animals excluded from the voyage.[108] It is unlikely that Buckland really believed that these "repeopling" species were saved on the Ark, and even less likely that he postulated a post-diluvial re-creation. If the long sought remains of humans in the diluvium had been found, how would Buckland have accounted for the survival of individual humans to repopulate the globe? Presumably, Buckland may have advocated Providentially provided areas of refuge, a sort of natural analogue to the Ark, but this key point is never addressed. Anything less than an Ark would only emphasize the deviations from scripture that characterized Buckland's supposedly "reconciled" deluge, and Buckland would have been content not to draw more attention to these differences.

The other attack on diluvialism was based on studies of the volcanoes of central France that produced a head-to-head conflict between a diluvial interpretation by Buckland's colleague and former student Charles Daubeny[109], and a strict actualist account by George Poulett Scrope. Daubeny, an advocate of the diluvial theory, had in his *Description of Active and Extinct Volcanoes* (1826) supported the theory that there was a division presented in the volcanic rocks of central France, particularly in the Auvergne region, between "modern" and "ancient" classes. In this classification, the flows of the "modern" lavas could be referred to the time since the excavation of the valleys, which to Daubeny made them post-diluvial lavas. Scrope, in his major

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[104] Fitton (1823), p. 229. Fitton accepted that the deluge was universal, but not that it was contemporaneous or transitory.

[105] Buckland (1825), pp. 312-315.

[106] Fleming (1826), pp. 219-233, almost every page of the sections on terraces, gravel beds, and mud assign to these phenomena "local" causes.

[107] Buckland (1825), pp. 308, 312.

[108] Fleming (1826), p. 235.

[109] Daubeny had succeeded Buckland's old professor John Kidd as Professor of Chemistry at Oxford in 1822.

work, *Memoir of the Geology of Central France* (1827), rejected the reality of this division, and instead argued that the lava had preserved a series of successive stages over a long period which demonstrated the gradual and continuous force of erosion caused by the river that flowed around the volcanic deposits.

Scrope's earlier work, *Considerations on Volcanos* (1825), had been completely dismissed by some reviewers,[110] but Lyell found much to admire in the work and was greatly disappointed by its reception.[111] One of Scrope's positions that Lyell quickly adopted was the belief in the heuristic impoverishment of geological theories based on the supposition of catastrophes. Scrope found the concept of catastrophes to be so ambiguous that "anything you choose to imagine" would conform to explanations that included them. The problem with this was that "it stops further inquiry" and in so doing, stops "the advance of the science by involving it in obscurity and confusion."[112] What geology required was the adoption of a method that begins with forces presently in existence and rejects any hypothesis containing other causes unless it could be shown that actual causes over an unlimited series of ages were inadequate to account for the observations under study. As a general rule, this would have been accepted by almost all geologists, but Scrope believed that anyone who still relied on catastrophes had not looked hard enough for a solution in strictly existing causes.

Lyell endorsed this view in his review of the *Transactions of the Geological Society* (1824).[113] In contrasting the opinions of Buckland and Hutton, Lyell conceded that the opinion that forces in the past repeatedly acted with more force than those presently observed was the more generally accepted view. For this reason, it was entitled "without doubt to the more respect," but Lyell took on the case of the underdog and echoed Scrope's argument that there was often a premature assumption that existing causes, acting through "the lapse of ages" could not produce the effects for which catastrophes were invoked. This assumption was "directly calculated to repress the ardour of inquiry, by destroying all hope of interpreting what is obscure in the past by an accurate investigation of the present phenomena of nature."[114] Lyell acknowledged that there had been great geological convulsions, even deluges, although not the transitory universal form Buckland defended, but contrasted these brief periods to the extensive intervals of calm that surrounded them. On this point again there was no disagreement with diluvialists like Buckland, who consistently advanced a context of "punctuated tranquillity" in the "histories" he developed.

Where there was disagreement was on the importance of identifying a cause for any deluge – a question that was connected to the very definition of what kind of explanation could be regarded as scientific. By the mid-1820s, the question of causes was being given a significance in the debate over diluvialism that it had never received previously. For all its speculation, the diluvial hypothesis could be accepted by zealous empiricists like Greenough

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[110] Most notably by John Macculloch in the *Westminster Review*, 5(1826): 356-373.

[111] Wilson (1972), p. 164.

[112] Quoted in Scrope (1858), *The Geology and Extinct Volcanos of Central France*, 2nd ed., viii.

[113] Lyell (1826), *Quarterly Review* 34: 507-540.

[114] Ibid., p. 518.

because the fact of a deluge seemed to them to be entailed by the evidence. They drew the demarcation line between speculation and observation at the point that allowed the inference of a deluge but prohibited any assignment of a cause of that deluge. The cause of the diluvial phenomena was to them demonstrated by observation, but the cause of the deluge was speculation that could be justifiably sidestepped. In an earlier period in geology, it was acceptable to leave the matter there and offer no further explanation. But by 1825 the anti-speculation approach of British geology was being openly questioned. Lyell wrote that he "must entirely disavow the influence of that fashion, now too prevalent in this country, of discountenancing almost all geological speculation."[115] The question of what caused the deluge could no longer be avoided, nor could it be answered. This absence of any "secondary cause" encouraged the suspicion that Buckland believed the direct influence of the First Cause was responsible for the deluge, but this was not the case. It would not be until 1840 that Buckland found what he believed to be "the grand key" to the diluvial theory in the glacial hypothesis of Agassiz.[116]

Lyell accepted Cuvier's evidence that there had in the past been deluges in the form of extensive coverage of the land by sea, but he assigned their cause to Playfair's theory of the rise and fall of the level of the land. Elevations and subsidence had been presently observed in the form of earthquakes, and there was evidence that there had been immense changes in the level of the land even in geologically very recent periods, which seemed to counter the claim that forces had decreased through time. This evidence had in fact been read to the Geological Society by Buckland in 1825.[117] Buckland had retreated somewhat from his reliance on denudation as the dominant cause of valley formation after uncovering strong evidence of valleys that had been caused by elevation. The "double" incline of the escarpment of these valleys showed signs of having been pushed up by a force acting beneath the surface. These elevations had occurred very recently in geological time: well after the deposition of the Plastic Clay and probably after the London Clay, both tertiary formations. Similar findings lead Léonce Élie de Beaumont to suggest that inundations were caused by elevations, but Buckland did not place any elevations near the time of his last deluge. Buckland still maintained that diluvial denudation later modified the valleys caused by elevations, but their existence could be traced to antediluvian time. There seemed to be some arbitrariness in Buckland's insistence that these elevations, which were "of frequent occurrence in the formations of all ages"[118] had suddenly and without explanation ceased to act at a period that was geologically not very long before his supposed deluge.

After the publication of Scrope's *Memoir* in the summer of 1827, Lyell was eager to publish a review of the book, in part to make up for the unjust criticism he believed Scrope had previously received. Buckland at this time was still concerned with distancing himself from the biblical literalism of Granville Penn and the "scriptural geologists," and he asked Lyell to use some of his review of Scrope to discredit their views.[119] On the whole, Buckland was doubtless

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[115] Lyell (1827), p. 441.

[116] Buckland manuscript, Oxford University Museum, quoted by Rupke (1983), p. 107.

[117] Buckland (1826), "On the Formation of the Valley of Kingsclere," *Trans. Geol. Soc.*, 2: 119-130. Read February 8, 1825.

[118] Ibid., p. 125.

[119] Wilson (1972), p. 173.

pleased with the result. Lyell scornfully described the scriptural geologists as writers "wholly destitute of geological knowledge" who inconsistently apply their literalist interpretations and "endeavour to point out the accordance of the Mosaic history with phenomena which they have never studied."[120] But along with attacking the integrity of the scripturalists, Lyell also took some shots at Buckland's geology: not only did he endorse Scrope's principal conclusions, he also incorporated into his essay some of the criticisms of the diluvial theory by his friend Fleming.

Apart from his promotional essays, Lyell's first original contribution to the campaign against the diluvial theory was research he conducted with Roderick Murchison (who, like Lyell, had studied geology under Buckland at Oxford, although not as a registered student) as a follow-up to Scrope's work in central France. In March 1828, Lyell and Murchison decided to spend the summer in Auvergne and other areas in France, examining the volcanoes and verifying Scrope's conclusions on valley formation.[121] Murchison, with advice from Scrope, left first and was joined by Lyell in May. It did not take very long for them to find what they were looking for. Almost immediately, Lyell wrote to his father about his discoveries:

> This is astonishing proof of what a river can do in some thousand or 100 thousand years by its continual wearing. No deluge could have descended the valley without carrying away the crater & ashes above.[122]

Ironically, Lyell and Murchison carried with them on their travels a copy of *Reliquiae Diluvianae* as a gift for a French geologist, and an letter of introduction from Buckland.[123] Within a year, Lyell would write that the evidence against the diluvial theory, including his work in Auvergne, was "enough to sink the *Reliquiae Diluvianae* for ever."[124]

Lyell and Murchison presented their research to the Geological Society in December 1828, confirming Scrope's earlier findings that no great inundation had recently flowed over the region.[125] The preservation of the evidence of successive states of the surface in the lava, over long periods of time, made it possible to trace an accurate long-term history of the effects of a flowing river on the surface of the neighbourhood. By being able to identify with certainty different stages in the formation of the surface, evidence that otherwise would have been regarded as indicating simultaneous processes could be shown to be from distinct periods.

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[120] Lyell (1827), pp. 482-483.

[121] Wilson (1972), p. 187.

[122] Ibid., p. 196.

[123] Ibid., p. 206.

[124] Letter to Gideon Mantell, June 7, 1829. Quoted in Wilson (1972), p. 264.

[125] The paper was read by Murchison, as Lyell was on a tour of Italy. The full paper was not published in the Geological Society's *Transactions*, but in the *Edinburgh New Philosophical Journal*, June 1829: 15-48. This was possibly because there was often a long delay in the publication of the *Transactions*, and Lyell and Murchison wanted a more timely distribution of their research.

> If the debris of all these various periods were now strewed over the country at the various elevations where they are at present observed, and if we possessed not the means, which we now have, of pointing out their different ages, they would present the appearance of having been the result of one sudden and dreadful catastrophe, whereby rocks of different ages were violently broken up, and carried, without the least reference to existing levels, to vast distances, often across deep ravines, and spacious intervening valleys.[126]

This statement implies that the hypothesis of a catastrophe was legitimately indicated by the data obtained in Britain and other areas where lava never flowed, but Lyell and Murchison could be generous to their opponents, because they had demonstrated what many had long believed: that gradual existing processes over a lengthy interval could be responsible for the excavation of valleys. Exactly how many valleys were actually formed this way, however, still remained a debated question.

Lyell and Murchison only provided a brief account of the fossils of the area, referring the reader to a forthcoming paper by Croizet and Jobert, but here too the results seemed devastating to Buckland's theories. The remains of the standard diluvial fauna: rhinoceros, hippopotamus, hyena, deer, etc., were found in formations that were immensely old – deposited before the recent lavas of Auvergne, and while some of the ancient volcanoes were still active.[127] Buckland had used the universal similarity of diluvial fauna as evidence that their extirpation must have occurred contemporaneously and suddenly around the world. He had emphasized that conclusion just a few months earlier, in April, when his examination of fossil bones collected in India by John Crawfurd indicated generally the same remains as found in the British diluvium.[128] But the findings in central France proved that there had been an extensive period of time during which these animals would have lived and died. A gradual account of their deaths over successive periods was now a reasonable possibility, leaving no reason to presume that they had suffered a sudden catastrophic end.

In the Presidential Address to the Geological Society, delivered two months after the presentation of Lyell and Murchison's research, Fitton emphasised the "great interest to theory" of their discoveries. Though he claimed that he wouldn't give an opinion on the debate over the sufficiency of existing causes, Fitton made it clear which side he took, stating that those who believed in the previous action of causes no longer existing will probably have to give way to the

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[126] Lyell and Murchison (1829), "On the Excavation of Valleys as Illustrated by the Volcanic Rocks of Central France," *Edinburgh New Phil. Journ.*, Apr. to Oct. 1829: 45. Read to the Geological Society December 19, 1828.

[127] Ibid.

[128] Buckland (1829), "Geological Account of a Series of Animal and Vegetable Remains," *Trans. Geol. Soc.* 2: 377-392. Read April 18, 1828. In the same paper, Buckland reaffirmed the distinction between alluvium and diluvium, and his belief in "the comparatively impotent exertions of existing causes." The main conclusion of the paper, however, was the correspondence of Asian and European strata, and the evidence that the Tertiary was extensively distributed.

theory that the appearance of the Earth is due to forces "permanently connected with the constitution and structure of the Globe."[129] In closing his address, Fitton endorsed not only gradualistic actualism, but Huttonian cycles which "acquire new probability from every step of our progress."[130] To Fitton, it was certain that a new era truly was emerging for geology.

The entire body of evidence that supported a contemporaneous, recent, universal deluge was now in question, but no less questionable in the opinion of many geologists was the conclusion that existing causes could account for the formation of every valley or the distribution of the superficial gravel. To assume that the evidence from central France was decisive against the diluvial theory was to commit the same error that the diluvialists were accused of making: a gratuitous generalization from local phenomena. Many supporters of the diluvial theory, including Buckland, Conybeare, and Daubeny saw nothing in the results from central France to make them abandon their ideas.

When Conybeare read his research on the valley of the Thames to the Geological Society in May 1829, he acknowledged the dispute over existing causes, labelling it as between the "diluvialist" and the "fluvialist," who ascribed valley formations to the long-lasting operation of rivers or to the force of "atmospheric" waters.[131] But he conceded nothing to the fluvialist position and outlined a four-stage history of the Thames which affirmed the evidence of violent action. How, Conybeare asked, could rivers explain the diffusion of gravel over every part of a plain, unless the river is assumed to have changed direction so often as to have covered over time the entire area. He challenged the fluvialists to account for the configuration of the valleys based on their theory. On both nights after the paper was read there was a spirited debate between Conybeare and Buckland defending diluvialism and Lyell and Murchison on the "fluvialist" side. Conybeare had identified four periods during which elevations and other events resulted in diluvial modifications to the surface. The fourth of these events was the customary geological deluge, the one responsible for the distribution of gravel, but the hypothesis of three others was, to Lyell, cause for celebration:

> He admits 3 deluges before the Noachian! & Buckland adds God knows how many catastrophes besides so we have driven them out of the Mosaic record fairly.[132]

This excited claim seems not to be supported by any changes in the diluvialist position – Conybeare's fourth deluge was still the only one that could be tied to the Mosaic record, the other

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[129] Fitton (1834), Presidential Address to the Geological Society, 1: 133. Read February 20, 1829. There is some irony in Fitton's comments as he sides with Lyell against Lyell's old professor, as Fitton – the pupil of Jameson – abandons his professor's views and endorses in the same address Huttonian cycles. Just six years earlier, in his review of the *Reliquiae*, Fitton wrote that "it is almost universally admitted that valleys have been excavated by causes no longer in action – contrary to the opinion of Dr Hutton and Mr Playfair." (1823: 227)

[130] Ibid., pp. 133-134.

[131] Conybeare (1829), "On the Valley of the Thames," *Proc. Geol. Soc.*, 1: 145.

[132] Letter from Lyell to Mantell, May 16, 1829, quoted in Wilson (1972), p. 264.

three were all many ages before the appearance of human beings. Sedgwick, at the time the Society's president and the chair of the meeting, apparently came down on the side of the fluvialists at the second meeting,[133] and Lyell speculated that the trouncing was so severe that the second volume of *Reliquiae Diluvianae* that Buckland had long planned would never be written.[134] But very few geologists were convinced that the forces allowed by Lyell's uniformitarian philosophy were adequate to explain all phenomena. The evidence no longer seemed to be compatible with a recent, universal flood, but Buckland was almost alone in advocating such an event. For other diluvialists, the evidence from central France produced no critical anomaly to their theories, but the discovery that diluvial fauna lived over many successive periods took away from Buckland what he considered to be the best evidence for a single contemporaneous deluge.

Recanting, 1830-1836

In the 1830s there were several significant retractions and modifications of the diluvial theory away from the single, universal event that Buckland's had supported. There were three main reasons for this withdrawal of support: first, the increased awareness of the possible long-term effects of existing causes; second, a more cautious stance on the mixture of geology with scripture; and third, the discovery of evidence that indicated that there had not been a single great deluge, but rather a series of local inundations. The last two went together, as proofs of successive inundations made the geological events even less like the Biblical flood to the point where they shared no common characteristics or time period, and no longer could be reasonably associated.

The first defector was Sedgwick, who had succeeded Fitton to the presidency of the Geological Society in 1829. Three weeks after the Geological Society meeting that Lyell had described as the death of diluvianism, Sedgwick travelled with Murchison on a tour of the continent that lasted much of the summer of 1829. According to Lyell, Sedgwick returned with his views so profoundly changed, that he "throws overboard all the diluvian hypothesis; is vexed he ever lost time about such a complete humbug."[135] Observations made during his tour with Murchison indicated that there had been an "epoch of elevation" in a period more recent than the formation of tertiary formations, and Sedgwick was beginning to consider whether elevations and not a single deluge may have been responsible for traditional "diluvial" phenomena.

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[133] How strongly Sedgwick took the fluvialist side and to what degree is not known. The only description of the meetings is from Lyell's one-sided account in letters to Gideon Mantell, quoted in Wilson (1972), p. 264. Sedgwick's ideas were undergoing a change that culminated in his partial renunciation of the diluvial theory in 1831, but he was never a supporter of the sufficiency of existing causes, the central dispute between fluvialism and diluvialism.

[134] As it turned out, Lyell was right. Buckland wrote to Edward Hitchcock in February 1830 that he had sufficient material for the second volume, but didn't have the time to put it together, *Am. Journ. Sci. and Arts* 18(1830): 393. Four months later, Buckland was selected to be one of the authors of the Bridgewater Treatises, a project that required six years to complete, and which indicates how little free time he really had.

[135] Quoted in Clark and Hughes (1894), p. 357.

In his first Presidential Address to the Geological Society, delivered in February 1830, Sedgwick discussed the paper of Lyell and Murchison, even though it had already been mentioned by Fitton in his review of the previous year.[136] The studies of central France had convinced Sedgwick that the valleys *of that area* had not been caused by a "great denuding wave or mass of water," and were actually the result of long continued erosion caused by existing rivers. Conybeare's research on the valley of the Thames that had indicated that only minor erosion was caused by flowing rivers is judged by Sedgwick to "leave untouched all the facts of an opposite kind, supported by direct evidence."[137] Sedgwick considers Conybeare's paper in between his reports on the conclusions of Lyell and Murchison on one side and Scrope on the other, giving the "fluvialists" both the first and last word. In expressing his own opinions, however, Sedgwick argued that both sides are too extreme, and that it was pointless to look exclusively to one cause as the dominant mode of valley excavation. Relying on his research with Murchison, he concluded that elevations had occurred throughout many different periods, and undoubtedly had an effect on valley formation through "the bursting of lakes, by great debacles, and in short by all the great phenomena of denudation." Whatever debacles there had been, however, were localized and occurred over an extensive period of time.[138] Buckland's universal interpretation was therefore rejected by Sedgwick, but he did not reject the evidence for a flood that Buckland had uncovered, and agreed with Buckland's description of valleys through the chalk as appearing "to have been swept out by one flood of retiring waters," but Sedgwick believed that these were exceptions and that most valleys were caused by a complex of forces.

While observations were leading Sedgwick to reject any occurrence of a single, epoch-ending flood, he was also compelled to reconsider his acceptance of the association of religious and geological ideas by the publication of Andrew Ure's *A New System of Geology* (1829). Sedgwick was greatly embarrassed and incensed by the appearance of this work of scriptural geology because it was the first such essay written by a member of the Geological Society. As Granville Penn and other similar writers had done before, Ure censured Buckland's theories for their divergence from scripture and presented a "new system" that was an explicit attempt to reconcile geology with Genesis. Sedgwick responded with the strongest words of censure that had ever been delivered in a Presidential address.[139] The publication of Lyell's *Principles of Geology* in July 1830 added to the disdain for associating geology with scripture by ridiculing such attempts as descendants of the discredited cosmogonists of the past. In Lyell's history, geological progress had always ended whenever Noah was summoned. Whatever scientific merits the diluvial theory had as an account of extensive but local and temporally divided deluges, the connection with scripture in the face of Ure's outrageous work had to be thoroughly abandoned.

In Sedgwick's second address a year later, he enthusiastically supported Élie de Beaumont's theory of successive elevations as an explanation for the series of local deluges that

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[136] Sedgwick (1830), *Proc. Geol. Soc.* 1: 189.

[137] Ibid., p. 190.

[138] Ibid., p. 191.

[139] Ibid., pp. 208-210. Such biting criticism from the chair became commonplace in the addresses of Murchison in 1832, 1833, and 1842.

had deposited gravel over extensive areas. With his acceptance of this new theory, Sedgwick retracted his earlier endorsement of Buckland's diluvial theory:

> there is, I think, one great negative conclusion now incontestably established – that the vast masses of diluvial gravel, scattered almost over the surface of the earth, do not belong to one violent and transitory period. It was indeed a most unwarranted conclusion, when we assumed the contemporaneity of all the superficial gravel on the earth. We saw the clearest traces of diluvial action, and we had in our sacred histories, the record of a general deluge. On this double testimony it was, that we gave a unity to a vast succession of phænomena, not one of which we perfectly comprehended, and under the name diluvium, classed them all together.
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> ...Having been myself a believer, and, to the best of my power, a propagator of what I now regard as a philosophic heresy, and having more than once been quoted for opinions I do not now maintain, I think it right, as one of my last acts before I quit this Chair, thus publicly to read my recantation.[140]

Not only did the scientific evidence indicate a series of local diluvial events, but none of them could be associated to the Mosaic flood because the remains of human beings were never found in the diluvium. Sedgwick also strongly criticized Lyell's uniformitarianism as an untenable hypothesis, and called the attribution of diluvial phenomena to the gradual action of existing rivers as "little better than a mockery of my senses."[141]

Later Presidential Addresses to the Geological Society contained similar rejections of Buckland's theory of a unified, universal deluge. Murchison in 1833, reporting on a paper by Deluc that also associated diluvial gravel with elevations, concluded that diluvial gravel had now to be looked upon as the effects of local events, and that geologists could "no longer attribute such drifts of sedimentary matter to one particular diluvial current."[142] Greenough followed the next year with his own retraction of support for the diluvial theory:

> The opinion [a universal and temporary deluge] was not hastily formed. My reasoning rested on the facts which had then come before me. My acquaintance with physical and geological nature is now extended; and that more extended acquaintance would entirely be wasted upon me, if the opinions which it will no longer allow me to retain, it did not also induce me to rectify. New data have flowed in, and with the frankness of one of my predecessors, I also now read my recantation.[143]

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[140] Sedgwick (1831), *Phil. Mag.*, 9: 313-314.

[141] This comment calls into question Lyell's account of the Geological Society meeting when Conybeare presented his paper on the Thames valley. Nothing in Sedgwick's own writing suggests he ever supported the "fluvialists."

[142] Murchison (1833), *Proc. Geol. Soc.*, 1: 443.

[143] Greenough (1834), *Proc. Geol. Soc.*, 2: 69.

Unlike Sedgwick and Murchison, however, Greenough attributed his change of mind to the work of Lyell in establishing that long-acting existing causes could have immense effect on geological formations.

Others who responded to Lyell's *Principles* were not as convinced. Buckland did not reply in print to his former pupil, but his friends William Conybeare and Charles Daubeny both took up the defence of the diluvial theory in published reviews. Conybeare's response focused on drawing a distinction that had never been emphasized prior to the publication of Lyell's book. Buckland and Conybeare had often written that "existing causes" were inadequate to account for the valleys of denudation and other supposed diluvial phenomena. Lyell had turned this into a point on which to denigrate diluvialists by making it seem as though their theories were therefore highly speculative and fantastic. Conybeare stressed the distinction between causes and intensities, claiming that "both parties equally ascribe geological effects to known causes, viz. to the action of water, and of volcanic power." The true difference was that the diluvialists interpreted the evidence as indicating a greater violence to these causes in earlier periods.[144]

Conybeare did not accept Élie de Beaumont's theory of periods of sudden elevations, and he was left without any mechanism to explain the cause of deluges. Much of his paper was a catalogue of observations that seem inexplicable by "fluvial" theories, and diluvialism received little direct support. The diminished regard for the diluvial theory is revealed by Conybeare's *Report on the Progress* of geology read at the second meeting of the British Association for the Advancement of Science (1832). In his 50-page report, Conybeare glosses over diluvialism, relegating it to a single, two-sentence paragraph.[145]

Charles Daubeny responded to Lyell's *Principles* and the arguments of Scrope in a lengthy letter to Jameson published in the *Edinburgh New Philosophical Journal*. He agreed that explanations that required only existing causes were the "*beau ideal*" of geology, and conceded that the diluvial theory had led to an underestimation of such forces. But he warned that the appeal of such solutions might make researchers overlook the deficiencies in particular actualistic theories.[146] After reading the other accounts of the volcanoes of central France, Daubeny saw no reason to abandon the antediluvial/postdiluvial distinction, noting that "such views are still espoused by the individuals who first gave them currency in this country." He supported Conybeare's argument that the diluvial theory relied only on existing causes and immutable laws, and consequently the difference between his ideas and Lyell's was reduced "almost to a question of degree."[147]

But despite Daubeny's efforts to create harmony between the theories of the diluvialists and the "fluvialists," his own position rejected two of the most significant arguments of Buckland and Lyell. Against Buckland, Daubeny asserted that he never believed the geological

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[144] Conybeare (1830), "An Examination of those Phenomena of Geology which seem to bear most Directly on Theoretical Speculations," *Phil. Mag. Ann. Chem.*, 8: 360.

[145] Conybeare (1832), "Report on the Progress, Actual State, and Ulterior Prospects of Geological Science," *Second Report BAAS*, p. 402.

[146] Daubeny (1831) "On the Diluvial Theory, and on the Origin of the Valleys of Auvergne," *Edinburgh New. Phil. Journ*. Oct 1830 to Apr 1831: 221, 228. Letter dated January 15, 1831.

[147] Ibid., p. 202.

evidence indicated a unified, global flood:

> With respect, indeed, to the universality of the Mosaic Deluge, since divines themselves are divided upon it, laymen may surely be allowed a certain latitude of opinion; and it has always appeared to me, that the phenomena to which geologists appeal in proof of the reality of the event alluded to, may be just as well explained by a number of partial though extensive floods, as a single universal one.[148]

Daubeny used the discoveries of Élie de Beaumont of successive elevations occurring around the world to account for the many floods that had inundated extensive portions of the surface of the Earth. The Mosaic Flood may have been one of these events, brought about by strictly natural causes.

Although Daubeny rejected Buckland's universalist position, he did not separate his own geology from the Biblical account of a flood, as Lyell insisted must be done. Daubeny, in fact, extended the limited connections Buckland and other diluvialists had supported, and expressly contended what Lyell most deplored: that scientific theories are strengthened by their correspondence to scripture.

> though a doctrine in science *may* be true, although involving conclusions that cannot be reconciled, at the time, to the statements of Scripture, it will be allowed to be somewhat more probable when in conformity to them. ...we shall be inclined to regard it as a recommendation of the view taken [the diluvial theory], that it confirms and accounts for an event which has reached us through such a variety of distant channels, that few probably would feel themselves justified in rejecting the fact of its occurrence.[149]

This view of scriptural conformity as an appropriate point on which to compare rival scientific theories was never endorsed by Buckland, and resembled more the approach of the scriptural geologists who had attacked Buckland's theories because of their supposed incompatibility with Genesis.

While the challenges to Buckland's theory of a unified, universal deluge were developing, Buckland was concentrating his research on comparative fossil studies. He identified in southern England the siliceous remains of a family of plants closely resembling the tropical Cycadeae[150] which he used to support the theory of a previous tropical climate in Britain at the time of the deposition of the oolite formation (upper Secondary). When Lyell and Murchison's paper on central France was being presented to the Geological Society, Buckland was completing his reconstruction of a new species of pterodactyl,[151] and preparing a fascinating study of fossil

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[148] Ibid., p. 206.

[149] Ibid., p. 205.

[150] Buckland (1829), "On the Cycadeoideae," *Trans. Geol. Soc.* 2: 395-401. Read June 6, 1828.

[151] Buckland (1835), "On the Discovery of a New Species of Pterodactyle," *Trans. Geol. Soc.*, 3: 217-222. Read February 6, 1829.

faeces discovered in several Secondary formations.[152] There is no indication that Buckland performed any cave research after 1825, and even his stratigraphal studies were minimal in this period. The notoriety he had received for his analysis of bones of the hyena den, along with his admiration of Cuvier's methods, had made Buckland one of the top bone and fossil researchers in Britain, a reputation that was guaranteed in 1824 when he wrote the first paper describing the newly discovered land dinosaur, *megalosaurus*.[153]

A few months before the publication of Lyell's *Principles*, Buckland presented to the Geological Society his final detailed local stratigraphal study, an examination of the area near Weymouth, Dorset that was written with Henry De la Beche.[154] This paper was remarkably similar in both approach and conclusions to Buckland's earlier work. The customary "history" of the region was outlined, in which the final significant event to affect the area was "the waters of a violent inundation" sufficient to excavate valleys of denudation and spread diluvial gravel.[155] But some modifications to Buckland's ideas were apparent in this work. No attempt was made to connect the findings at Weymouth to those from other areas – this was a strictly local study, even if many of the conclusions fit into the universal flood framework that Buckland had previously established. Some of this local emphasis may have been due to De la Beche, who stressed in his *Geological Manual* (1832) the distinction between local details and general conclusions. Although he did not reject the theory of a single contemporaneous deluge, De la Beche believed that it was produced by "premature generalizations of local facts."[156] In the Weymouth study, the diluvial period had been preceded by "a tremendous catastrophe" that produced elevations and other great changes, but Buckland and De la Beche do not speculate whether this was the cause of the inundation, other than to allow that "the relation of one to the other may possibly be nearer than has been hitherto apprehended."[157] This was Buckland's first acknowledgment that the phenomena he had consistently interpreted as supporting a universal deluge may actually have been produced by local events causing localized floods.

Shortly after Buckland had presented this more flexible account of diluvial phenomena,

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[152] Buckland (1835), "On the Discovery of Coprolites, or Fossil Faeces," *Trans. Geol. Soc.*, 3: 223-236. Read February 6, 1829.

[153] Buckland (1824), "Notice on the Megalosaurus," *Trans. Geol. Soc.*, 1: 390-396. Read February 20, 1824.

[154] Buckland and De la Beche (1830), "On the Geology of the Neighbourhood of Weymouth," *Trans. Geol. Soc.*, 4: 1-46. Read April 2 and 16, 1830.

[155] Ibid., pp. 43, 46.

[156] Ibid., p. 155. The one theory De la Beche did reject was Lyell's uniformitarianism, which he described as "valueless and unphilosophical."

[157] Buckland and De la Beche (1830), p. 44. Buckland apparently didn't want to make the connection too strong: in the initial paper read to the Geological Society, the "history" of the area was divided into seven parts, with the elevations and inundation assigned to the same period, *Phil Mag.* 7: 458. By the time the full paper appeared in the Geological Society's *Transactions*, the "history" had been expanded to eight periods, with the only change being the separation of the elevations and inundation into separate periods, *Trans. Geol. Soc.*, 4: 46.

he was selected by Davies Gilbert, Davy's successor as President of the Royal Society, and William Howley, Archbishop of Canterbury, to write the geological volume for the Bridgewater Treatises. In his will, Francis Henry Egerton, Earl of Bridgewater, had left ,8,000 to the Royal Society to be paid to the person or persons nominated by the President to prepare "a work On the Power, Wisdom, and Goodness of God as manifested in the Creation." The writers were also to be given the profits from the sale of the works.[158] The connection of the project with monetary reward was seen as nearly scandalous by some, and led to the refusal of a few selected writers, such as John Herschel, to become involved with such "repugnant" matters.[159]

Buckland was one of the first selected to contribute, and was the last to complete his volume. Most of his free time from 1830 to 1836 seems to have been spent working on this project, and he published very few geological papers during this period, the most notable being a study of sloths and a lecture on their ancient counterparts, the megatherium, delivered to the Oxford meeting of the BAAS in 1832.[160] When Buckland's Treatise, *Geology and Mineralogy* finally appeared in September 1836, it greatly disappointed those who were looking to Buckland for a defence of the geological demonstration of Noah's flood. In a footnote, but not quite buried, Buckland abandoned his theory of a recent, unified, universal flood, citing the recent findings that the "diluvial" fauna from around the world -- which Buckland had assumed lived in a single period, indicating an extensive contemporaneous flood -- had in fact lived over many periods of time:

> Discoveries which have been made since the publication of this work [*Reliquiae Diluvianae*], show that many of the animals therein described, existed during more than one geological period preceding the catastrophe by which they were extirpated. Hence it seems more probable, that the event in question, was the last of the many geological revolutions that have been produced by violent irruptions of water, rather than the comparatively tranquil inundation described in the Inspired Narrative.[161]

Not only did Buckland remove the connection between the geological and scriptural floods, he now accepted what Playfair had written long ago: it would be impossible to find any evidence of Noah's flood, because the description given in the Bible indicates that it was a quiet event:

> It has been justly argued, against the attempt to identify these two great historical and natural phenomena, that as the rise and fall of the waters of the Mosaic deluge are described to have been gradual, and of short duration, they would have produced comparatively little change on the surface of the country they

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[158] From the *Notice* printed in the front of all Bridgewater Treatises.

[159] Brock (1966), "The Selection of the Authors of the Bridgewater Treatises," *Notes & Rec. Royal Soc.*, 21: 162-179.

[160] Buckland (1832), "On the Fossil Remains of the Megatherium," *Report BAAS* 1831 1832, 104-107; Buckland (1837), "On the Adaptation of the Structure of the Sloths to their peculiar Mode of Life," *Trans. Linnaean Soc.* 17: 17-27. Read March 19, 1833.

[161] *Geology and Mineralogy* (1836), p. 95.

overflowed.[162]

The connection between the two floods was also weakened by the continuing absence of human bones from the diluvium, suggesting that the geological deluges were all from a period before the appearance of human beings.[163]

In spite of Buckland's efforts to downplay his own recantation, his reviewers made certain that this footnote received proper acknowledgement. Scrope, in a review for the *Quarterly Review* that appeared five months before the publication of Buckland's work, announced that Buckland now believed that the main object of his *Reliquiae* was "utterly untenable; and, accordingly, he quietly renounces it in a note."[164] Buckland had also warned that his proposals "require some modification of the most commonly received and popular interpretation of the Mosaic narrative,"[165] and Scrope was quick to amplify this statement and assail those who neglected geology because it did not fit their "too literal" interpretation of scripture.[166] These were not the points that Buckland wanted to be emphasized. Oxford at this time was caught up in the beginnings of the Tractarian movement and its efforts to return the university to a strictly orthodox path, emphasizing the authority of revealed religion and disparaging scientific teaching. Buckland's separation of geological history from scripture and his "modifications" to accepted interpretations did not come at a very comfortable time.[167] Robert Bakewell, author of the successful *Introduction to Geology* (1828, 1833) suggested that this may have been the reason for the delay in the publication of *Geology and Mineralogy* after Scrope's early review.[168]

Buckland maintained the rhetoric of reconciliation in his Treatise, claiming that "even the letter of the text of Genesis" was reconciled with the phenomena of Geology,[169] but he achieved this harmonization by stressing that the two really had nothing to do with each other. There were only two points on which the discoveries of geology and scripture overlapped: the deluge, which Buckland now admitted were separate events, and the age of the earth, for which geology and revealed religion produced immensely different estimations that Buckland reconciled by interpreting the word "beginning" in the first verse of Genesis to indicate an undefined period of time.[170] Geological time was found in a single word in the Bible, and evidence for Noah's deluge

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[162] Ibid.

[163] Ibid.

[164] Scrope (1836), *Quarterly Review*, 56: 34.

[165] Buckland (1836), p. 14.

[166] Scrope (1836), p. 32.

[167] See Rupke (1983), Ch. 20, "Oxford's Tractarians against Geology," pp. 267-274. This seems to require some modification to the thesis that Buckland's geology was "adjusted" to suit Oxford.

[168] Quoted in Fulton and Thomson (1947), *Benjamin Silliman*, p. 155.

[169] Buckland (1836), p. 33.

was not to be found on Earth – that was how Buckland "reconciled" Genesis and geology.

Given the opportunity to demonstrate the religious significance of geology by the Bridgewater grant, Buckland chose to focus exclusively on natural religion.

> By the exercise of our Reason, we discover abundant evidences of the Existence, and of some of the Attributes of a supreme Creator, and apprehend the operations of many of the second causes or instrumental agents, by which He upholds the mechanism of the material World.[171]

If the attributes of God are shown by the secondary causes He uses, then what are these attributes? Benevolence is one quality that Buckland saw demonstrated in the operations of nature, and he gave several examples of the testimony provided by geology of God's benevolence, even finding it in the "scene of perpetual warfare" presented by nature.[172] But the one attribute of God that Buckland emphasized above all others is of God "the Universal parent,"[173] and the stated goal of Buckland's Bridgewater Treatise is "to demonstrate the Unity and Universal Agency of the *same* eternal and supreme First Cause of all things."[174] The search for unity and universality was no longer sought in a single universal geological event, or in universal formations, but rather in "the great chain" of living and extinct creations that prove "the unity and universal agency of a common great first cause."[175] Buckland found in paleontology what he believed he had found in his diluvial geology: a manifestation of the universality of God.

His manner of presenting evidence remained remarkably similar. In writing about universality in the organic world, Buckland often sounded just as he did when dogmatically asserting that diluvial phenomena are seen everywhere on the face of the earth:

> [The Sloth] adds another striking case to the endless instances of perfect mechanism and contrivance which we find pervading every organ of every creature[176]

Instead of proving universality through the recurring local evidence for a deluge, Buckland uses "the perfect method" of Cuvier -- comparative anatomy -- to prove a universal creator through the recurring similarities of living forms. This passage from *Geology and Mineralogy* is, with

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[170] Ibid., p. 19. Buckland had suggested this approach in his Inaugural Lecture (1820), pp. 31-32.

[171] Ibid., pp. 588-589.

[172] Ibid., pp. 129-134.

[173] Ibid., p. 110.

[174] Ibid., p. 582.

[175] Ibid., p. 114.

[176] Buckland (1837), "On the Adaptation of the Structure of the Sloths," *Trans. Linnaean Soc.*, 17: 23.

appropriate changes, identical to the methods of induction he applied to diluvial phenomena:

> the argument which would infer an Unity of cause, from unity of effects, repeated through various and complex systems of organization widely remote from each other in time and place and circumstances, applies with accumulative force, when we...can expand the details of facts on which it is founded, over the entire surface of the present world[177]

The similarities between Buckland's methods in developing the diluvial and his admitted methods for demonstrating the attributes of God are so striking, that there can be no doubt that the fervent support Buckland gave to his theory of a unified, universal deluge was at least partly inspired by the deep religious significance he saw in the geological demonstration of a universal force, a unity behind the particular phenomena observed throughout the world. Where Buckland's diluvialism shows remarkable consistency with his approach to natural theology, it shows great divergence from revealed religion, as his critics were always eager to point out. Buckland's theory of violent waves was never anything like the Biblical event except for one characteristic: its universality. Because of this, and because Buckland liked to label his work in its public expressions "reconciliation," it seemed apparent that his inductive leap from local evidence to a universal deluge was motivated by a desire to link his geology with scripture. But if that was his motive, the results were far from impressive, and deserved to be called *religio hæretica*. If, however, we interpret Buckland's advancement of the diluvial theory as an grand attempt to uncover "the Universal parent" in geology, its theological implications are much less heretical. The sources of Buckland's strongest statements of the harmony of diluvial theory with revealed religion are his Inaugural Lecture and the dedication to the *Reliquiae*, both of which were statements of the relevance of geology to the Oxford curriculum. Buckland, no less than Lyell, was capable of writing "in the language of an advocate," but where Lyell's training had been in the law, Buckland's had been in theology. Buckland presented his geology in these two instances as having a direct association with revealed religion – the foundation of Oxford instruction – but in his geological papers all such connections are disregarded. The theological influence that does pervade Buckland's geology is his search for the Universal, not his search for Noah.

In the end, Buckland had to abandon this search for universality in diluvial phenomena. If Buckland's theories had been scripturally-based, this probably would have been a very difficult step – ideas based on religion are seldom given up easily. But Buckland abandoned his theory of a universal deluge without any dogmatic persistence as soon as the geological evidence contradicted it and a better theory became available. This move did not exhibit any signs of a loss of piety or faith, because the theological beliefs inherent in his diluvial theory were not abandoned, but merely shifted to his interpretation of paleontological evidence.

If Buckland's theology was not so heretical, neither was his science very fantastic. The desire to find universality certainly led to some hasty generalizations, but the diluvial theory largely stood and fell on the evidence, even if the evidence may have been easier to see by those with a predisposition to believe in a great flood, and easier to dismiss by those embarrassed by the mixture of religion and science. The diluvial theory had the support of many of the finest geologists in England, even if most of them would never go as far as Buckland in endorsing

[177] Buckland (1836), p. 583.

universality. It is true that Buckland's diluvial research was more speculative than other papers presented to the Geological Society, but his theorizing had a liberating effect on the Society, whose papers until that point had been descriptive details that were both insignificant and unimpressive. Buckland's diluvial work, and the papers that were written both in support and in opposition to diluvialism were the most progressive research performed by the members of the Geological Society in the 1820s.

Buckland never abandoned his belief that great waves had been responsible for much of the surface features of the Earth. After he accepted Louis Agassiz's glacial theory in 1840, Buckland integrated glaciers into his system, proposing that melting glaciers had been the source of the flood waters.[178] The long-delayed second edition of *Reliquiae Diluvianae* was again planned, now to be called "Relics of Deluges and Glaciers," but it too was never written. In fact, Buckland wrote very little geology at all after 1841, even though he was only 57, and continued to hold his lectures at Oxford every year until becoming infirmed in 1849. To attribute Buckland's sudden lack of interest in geological research to an absence of perceived theological significance is perhaps a stretch, but his later papers indicate that Buckland's search for the Universal in geology ended with *Geology and Mineralogy.*

[178] Buckland manuscript, Oxford University Museum, quoted by Rupke (1983), p. 107.